



Deep Underwater Technology Improves the Safety and Reliability of Offshore Operations

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Abstract: Offshore operations are activities that require a high level of safety and reliability because they are carried out in a marine environment that has different conditions from activities on land. Waves, ocean currents, pressure, weather, and seabed conditions can affect the equipment and infrastructure used. One of the important parts in supporting these activities is subsea technology. This technology is used in various activities, from monitoring the condition of equipment, installing and operating underwater facilities, to inspecting and maintaining infrastructure. The use of underwater technology can help reduce work done directly by humans in risky environments. In addition, technologies such as remotely operated vehicles (ROVs), sensors, monitoring systems, and inspection devices can help determine the condition of equipment more quickly. However, the application of underwater technology also has several challenges, such as high costs, the need for experts, unpredictable marine environmental conditions, and equipment maintenance needs. Therefore, the use of underwater technology needs to be carried out with good planning and supervision in order to improve safety while maintaining the reliability of offshore operations in the long term.

Keywords: Subsea Technology; Offshore Operations; Safety; Reliability; Inspection

1. Introduction

Offshore activities are one of the important parts of the energy and marine industry. These activities can include the production process, transportation, installation of facilities, and maintenance of various infrastructures at sea. In contrast to onshore activities, offshore operations face more complex environmental conditions. Ocean waves and currents can change, the weather is not always predictable, and most equipment must work in conditions that are difficult for humans to reach directly. These conditions make safety and reliability aspects very important [1].

Technological developments then provide many options to help work in the underwater environment. Underwater technology can be used to conduct inspections, monitoring, data collection, and assist in the maintenance process of facilities. One example is the use of ROVs that can be controlled from the surface to see the condition of equipment or structures under the sea. In this way, work that poses a risk to workers can be carried out with the help of equipment so that direct contact with hazardous environments can be reduced [2].

Reliability is also no less important in offshore operations. Damage to one piece of equipment can cause disruption to the operating process and under certain conditions can pose a safety risk or economic loss. Therefore, the condition of the equipment needs to be known before the damage becomes greater. Monitoring and inspection systems with the help of underwater technology can be used to obtain information about the condition of the facility at regular intervals [3].

According to the author, the development of underwater technology is not only about the use of increasingly sophisticated equipment. What is more important is how the technology can be used to help workers, reduce the risk of accidents, and keep facilities operating properly. Therefore, the application of underwater technology needs to be adjusted to the needs and conditions of the field.

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2. Discussion of the Main Problem

The main problem in offshore operations is how to keep activities safe and running properly even though they are carried out in an environment that has many risks. Infrastructure such as underwater pipelines, support structures, production equipment, and other facilities continue to be influenced by the marine environment. Currents, waves, pressure, temperature changes, and seabed conditions can cause a deterioration in equipment condition if regular inspections and maintenance are not carried out [4].

One of the problems that is often a concern is the difficulty of conducting inspections of facilities that are underwater. Workers cannot easily conduct inspections directly at a certain depth due to safety risks and limited working time underwater. These conditions make the use of equipment such as ROVs and underwater inspection tools essential. These equipment can help see the condition of structures, take pictures or videos, and collect information without requiring workers to be directly in a risky location [5].

In addition to inspections, monitoring the condition of the facility is also an important part of maintaining the reliability of operations. Data from sensors and monitoring systems can help operators know if there are changes in equipment conditions. For example, if there is a change in the condition of the structure or signs of damage appear, further inspection actions can be taken before the problem develops into a larger breakdown. Thus, technology can help change maintenance patterns from only repairing after damage has occurred to focusing more on prevention [6].

However, the application of underwater technology also has its own problems. Equipment must be able to work in marine conditions that are not always stable and must receive regular maintenance. In addition, the cost of procurement and operation of underwater technology is quite large and requires personnel with special abilities. Therefore, companies or managers need to consider the benefits of technology compared to their costs and operational needs.

3. Review and Criticism of Existing Approaches

Various approaches have been used to improve the safety and reliability of offshore operations. One is to conduct regular inspections of underwater facilities. Inspections can be carried out using divers as well as equipment such as ROVs. These methods can help find damage, changes in structural conditions, or other problems that may not be visible from the surface [7].

The use of ROVs has several advantages because they can reach areas that are difficult for humans to do. ROVs can also be equipped with cameras and various equipment to help with the inspection process. However, the use of ROVs does not mean that there are no drawbacks. Its operation requires trained personnel, appropriate equipment, and supportive operational conditions. In poor marine conditions, the inspection process can also be more difficult [8].

Another approach is the use of sensors and monitoring systems. These systems can help provide information about the condition of the facility more regularly. With the data obtained from monitoring, operators can more easily determine when inspections or maintenance need to be carried out. However, the large amount of data produced also requires a processing system and personnel that are able to read and understand the information.

According to the author, an approach that relies on only one type of technology does not necessarily provide maximum results. ROVs, sensors, manual inspections, and monitoring systems should be used according to needs. Technology should also not only be chosen because it is considered modern, but must be seen from its capabilities, location conditions, costs, and benefits to the safety and reliability of operations [9].

4. The Author's Perspective or Argument

According to the author's view, underwater technology has a considerable role in improving the safety and reliability of offshore operations. The underwater environment is difficult to reach and has many risks, so the use of technology can help reduce the work that must be done directly by humans. With the presence of ROVs, sensors, underwater cameras, and monitoring systems, the condition of facilities can be better known.

The authors also argue that underwater technology should be used as part of a safety and maintenance management system, not just as an additional tool. Technology will be more useful if the data generated is actually used to make decisions. For example, the results of an inspection can be used to determine whether a facility is still safe to use or needs improvement [10].

In addition, the success of using technology is not only determined by the sophistication of the equipment. The human factor still has an important role. Operators and technicians must understand how to use the equipment and be able to read the results of inspections and monitoring. Maintenance planning must also be

carried out regularly so that the technological equipment used can still work properly.

According to the authors, the application of underwater technology needs to be carried out gradually and adjusted to the needs of each operation. With good planning, technology can help reduce the risk of accidents, detect problems early, and keep facilities functioning for a longer period of time [11].

5. Conclusion

Underwater technology can be one of the important parts in improving the safety and reliability of offshore operations. Difficult marine environmental conditions and many risks make inspection and monitoring of facilities not an easy job. The use of ROVs, sensors, underwater cameras, and monitoring systems can help do the job more safely and effectively [12].

Although it has many benefits, underwater technology also has several challenges, such as high costs, the need for experts, equipment maintenance, and environmental conditions that can affect the operating process. Therefore, the selection of technology needs to be made based on the needs and conditions of the field, not just based on the level of sophistication [13].

Ultimately, the safety and reliability of offshore operations do not depend solely on technology. Good management, worker capability, regular inspections, maintenance, and supervision remain necessary. By combining technology and proper management, risks in offshore operations can be reduced and facilities can be used more safely and reliably [14].

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